PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-202372

(43)Date of publication of application : 30.07.1999

(51)Int.Cl. G02F 1/19
G09F 9/37

(21)Application number : 10-020304

(22)Date of filing : 16.01.1998

(71)Applicant : BROTHER IND LTD

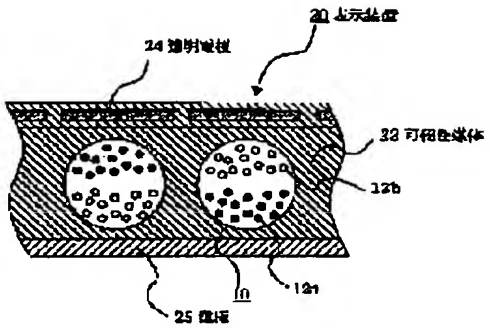
(72)Inventor : IGAMI ATSUSHI

(54) DISPLAY MECHANISM

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a display mechanism provided with a low driving voltage, high reflectivity in a reflection type system, high contrast and a memory function at the interruption of control electric field.

SOLUTION: In this display mechanism, optical reflection characteristics are changed and a required display operation is performed by changing the distribution state of charged particles 12a and 12b under the action of a voltage for control inside a dispersion system enclosing the charged particles 12a and 12b moved between electrodes by applying an electric field in a dispersion medium. The dispersion system is constituted of at least two or more kinds of the charged particles 12a and 12b included in a microcapsule 10 and the dispersion medium containing surfactant and the charged particles 12a and 12b contain at least one of titanium oxide and carbon black.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] Within the dispersed system which enclosed the charged particle which moves inter-electrode to impression of electric field in a dispersion medium By changing the distribution condition of said charged particle under an operation of the electrical potential difference for control In the display device to which give change to an optical reflection property and made it make a necessary display action carry out It is the display device which said dispersed system consists of at least two or more kinds of charged particles by which endocyst was carried out to the microcapsule, and a dispersion medium containing a surface active agent, and is characterized by said charged particle containing at least one side among titanium oxide and carbon black.
[Claim 2] A charged particle is a display device according to claim 1 characterized by including both titanium oxide and carbon black.
[Claim 3] It is the display device according to claim 1 or 2 which the volume of each charged particle is below 25 capacity % more than 1.5 capacity % to the volume of a microcapsule, respectively, and is characterized by total of the volume of all charged particles being below 50 capacity % more than 1.5 capacity % to the volume of a microcapsule.
[0001]

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention] This invention relates to the display device which controls the migration direction of a charged particle by impression of the electric field for control, and was made to carry out image formation about the display device using the charged particle which moves inter-electrode to impression of electric field in a dispersion medium.
[0002]
[Description of the Prior Art] Conventionally, the various things from a CRT (Cathode Ray Tube: cathode-ray tube) method to the method visualized using a liquid crystal (Liquid Crystal) method, a plasma luminescence method, EL (electroluminescence) method, etc. as a method which displays an image, text, etc. exist.
[0003] In recent years, the reduction in a miniaturization, lightweight-izing, and driver voltage, low-power-izing, thin flat panel-ization, etc. are called for also from the display device with the miniaturization of the various electronic instruments by rapid advance of semiconductor technology.
[0004] From the request mentioned above, very many kinds, such as a luminescence mold represented by PDP (Plasma Display Panel) and a light-receiving mold represented by LCD (Liquid Crystal Display), of flat panel mold electronic display devices are proposed, and practical use is presented. In that it is a low power, especially research of the reflective mold LCD is briskly done also in these in recent years.
[0005] As a merit of the reflective mold LCD, the point of having the display quality which has neither concordance nor the effect of outdoor daylight to like in an eye like printed matter etc. is listed at the bottom of the point in which the reduction in a miniaturization, lightweight-izing, and driver voltage, low-power-izing, the formation of a thin flat panel, etc. are possible, and the usual light source.
[0006]
[Problem(s) to be Solved by the Invention] However, theoretically in the reflective mold LCD, only the image of 66% of reflection factors and a contrast ratio 5:1 is obtained also as a configuration which combined the TFT panel with guest-host liquid crystal.
[0007] This was far and there was a problem that an image was hard to see in the image quality of 80% of reflection factors which are near infinite image quality and the output image by the calender or the laser beam printer has in the image of the newspaper of 57% of reflection factors, and a contrast ratio 5:1, and a contrast ratio 21:1. Moreover, while being unable to maintain image display but performing image display when control electric field were intercepted since it does not have a memory, always LCD had to continue adding a stimulus of electric field etc. to the screen from the exterior, it could not be easily used for it, and it had the problem also economically of being disadvantageous.
[0008]
[Means for Solving the Problem] A high reflection factor [in / in this invention person / a "low driver voltage" "reflective mold method] in order to solve these problems, As a result of inquiring wholeheartedly for the purpose of developing the display device in which these functions are realized, paying attention to high contrast" and "the memory effect at the time of control electric-field cutoff", it sets in a microcapsule. By moving the charged particle containing a pigment by inter-electrode by impression of electric field, the image display gestalt which performs the image writing to the screen is convenient, and finds out that it can realize, and it came to complete this invention.
[0009] In order to attain the above-mentioned purpose, a display device according to claim 1 Within the dispersed system which enclosed the charged particle which moves inter-electrode to impression of electric field in a dispersion medium By changing the distribution condition of the above-mentioned charged particle under an operation of the electrical potential difference for control In the display device to which give change to

an optical reflection property and made it make a necessary display action carry out The above-mentioned dispersed system consists of at least two or more kinds of charged particles by which endocyst was carried out to the microcapsule, and a dispersion medium containing a surface active agent, and the above-mentioned charged particle is characterized by including at least one side among titanium oxide and carbon black.
[0010] Since the adsorption power to a microcapsule wall generates the charged particle containing a pigment according to the display device of the claim 1 above-mentioned publication, by the hysteresis over electric field occurring as a result, and changing the impression condition of an electrical potential difference, change can be given to the optical reflection property using this display device of a display, and, moreover, a low battery is enough as the applied voltage at this time.
[0011] Moreover, by using the charged particle which contains at least one side among titanium oxide and carbon black, a reflection factor and a contrast ratio are high and become realizable [the display device in which it has a legible image etc.]. Moreover, even if it intercepts that two or more kinds of charged particles exist in a microcapsule, and control according after image formation and to electric field conjointly, it is possible to hold an image in the condition as it is.
[0012] Moreover, since the charged particle is contained in the microcapsule, even if it is hard to generate big condensation of charged particles at the time of an operation of electric field and it changes the impression condition of an electrical potential difference at it repeatedly, the fall phenomenon of image quality is not generated. Furthermore, it is also possible by making film-like base materials, such as paper, fix a microcapsule to form a rewritable flexible medium.
[0013] Moreover, the charged particle is characterized by a display device according to claim 2 containing both titanium oxide and carbon black in the display device of the claim 1 above-mentioned publication. According to the display device of the claim 2 above-mentioned publication, since a charged particle contains both titanium oxide and carbon black, it can realize a high reflection factor and high contrast.
[0014] Moreover, in a display device according to claim 1, the volume of each charged particle of a display device according to claim 3 is below 25 capacity % more than 1.5 capacity % to the volume of a microcapsule, respectively, and total of the volume of all charged particles is characterized by being below 50 capacity % more than 1.5 capacity % to the volume of a microcapsule.
[0015] According to the display device of the claim 3 above-mentioned publication, since total of the volume of each charged particle and the volume of all charged particles is specified as mentioned above, a charged particle shows good responsibility to electric field, and becomes possible [realizing the display device in which it has a high contrast ratio].
[0016]
[Embodiment of the Invention] Hereafter, it explains, referring to drawing about the gestalt of operation of the display device of this invention. The display device of this invention is a display device to which give change to an optical reflection property and made it make a necessary display action carry out by changing the distribution condition of the above-mentioned charged particle under an operation of the electrical potential difference for control within the dispersed system which enclosed the charged particle which moves inter-electrode to impression of electric field in a dispersion medium.
[0017] And the above-mentioned dispersed system which constitutes this display device consists of at least twc or more kinds of charged particles by which endocyst was carried out to the microcapsule, and a dispersion medium containing a surface active agent, and the above-mentioned charged particle contains at least one side among titanium oxide and carbon black.
[0018] The dispersed system which constitutes a part for the principal part of the above-mentioned display device, i.e., a microcapsule, is explained first. On these specifications, it is made a microcapsule including a microcapsule and its endocyst object.
[0019] Drawing 1 is the explanatory view having shown typically an example of the microcapsule which constitutes the display device of this invention. The charged particle 12 which consists of much black charged particle 12a and white charged particle 12b, and the liquid dispersion medium 14 are enclosed with this microcapsule 10.
[0020] Although the charged particle 12 is usually constituted by the binder for fixing a coloring agent and the coloring agent concerned, it may consist of only coloring agents. Generally as the above-mentioned coloring agent, grinding impalpable powder, such as well-known organic and minerals pigment of colloidal particle; versatility, a color, a metal powder, glass, and resin, etc. is mentioned, for example.
[0021] Especially as the above-mentioned organic pigment, it is not limited, for example, is Hansa. Yellow, Benzine Yellow pigments, such as Yellow ;P armanent Red, benzine orange, pyrazolone orange, vulcan orange,

orange lake, para red, lakered, toluidine red, brill fast scarlet, brill carmine, brill scarlet, bordo, watchung red, lithol red, bon maroon, lake bordo, rhodamine, madder Red pigments, such as lake; rhodamine b lake, dioxazine violet, crystal Purple pigments, such as violetlake; victoria pure blue lake, victoria blue lake, phthalocyanine blue, fast sky blue, threne blue Blue pigments, such as rs, diamonde green lake, phthalocyanine green, pigment green b, green Green pigments, such as gold, diamond Black pigments, such as black, etc. are mentioned.

[0022] Especially as the above-mentioned inorganic pigment, it is not limited, for example, white pigments, such as black pigment; titanium oxide, such as carbon black, an aluminum oxide, a zinc oxide, lead oxide, and oxidation tin, etc. are mentioned. The above-mentioned inorganic pigment and an organic pigment may be used independently, and may use two or more sorts together.

[0023] It is not limited especially as the above-mentioned color, for example, azo dye, metal complex dye, naphthol dye, anthraquinone dye, an indigo color, a carbonium pigment, a kino imine color, cyanine dye, quinoline dye, nitro dye, nitroso dye, a benzoquinone color, a naphthoquinone color, the North America Free Trade Agreement RUIMIDO color, a PENORIN color, phthalocyanine dye, etc. are mentioned. The above-mentioned color may be used independently and may use two or more sorts together.

[0024] In this invention, at least two or more sorts of charged particles 12 containing either [at least] titanium oxide or the carbon black are used as a coloring agent. Although titanium oxide is used for white charged particle 12b and carbon black is used for black charged particle 12a, respectively, two or more sorts of charged particles 12 which contain the coloring agent of other classes as black charged particle 12a or white charged particle 12b may be used, and the charged particle 12 containing the coloring agent of colors other than the above-mentioned black or white may be used.

[0025] Since it excels extremely in respect of a whiteness degree or concealment nature and carbon black shows perfect black, by using the charged particle 12 containing at least one side of these, a reflection factor and the contrast ratio of titanium oxide are high, and it can realize the display device in which it has a legible image etc.

[0026] Furthermore, a higher reflection factor and high contrast are realizable by using the charged particle 12 which contains both titanium oxide and carbon black, respectively as a coloring agent. As a white coloring agent, when things other than titanium oxide are used, since it is tinctured a little with transparency, a whiteness degree may fall in the liquid dispersion medium 14, only by the white polymer particle which it becomes difficult to obtain the high whiteness degree even like white paper, and does not contain titanium oxide. Moreover, as a black coloring agent, when things other than carbon black are used, a charged particle 12 may wear redness or may wear blueness.

[0027] When a color is used as a coloring agent, although it is also required that it should not have a bad influence on the property which distributes to the binder which constitutes a charged particle 12, and is not dissolved in the liquid dispersion medium 14, and the electrification nature of a charged particle 12, in order that a charged particle 12 and the liquid dispersion medium 14 may use an organic substance, generally the color which fulfills such properties will be limited.

[0028] Moreover, the color which does not dissolve in the liquid dispersion medium 14 has some which may be unable to color a charged particle 12 easily and are inferior in lightfastness further compared with a pigment, and may become unsuitable for use in a long period of time.

[0029] Although not limited especially as the above-mentioned binder, the organic substance which carries out the following is desirable. As this organic substance, composts, such as synthetic resin and a synthetic wax, a natural wax, etc. are mentioned, for example.

[0030] As a monomer component which constitutes the above-mentioned synthetic resin and a synthetic wax For example, methyl acrylate, ethyl acrylate, n-butyl acrylate, i-butyl acrylate, 2-ethylhexyl acrylate, cyclohexyl acrylate, Tetrahydro furil acrylate, methyl methacrylate, ethyl methacrylate, N-butyl methacrylate, i-butyl methacrylate, 2-ethylhexyl methacrylate, Stearyl methacrylate, lauryl methacrylate, the methyl vinyl ether, Ethyl vinyl ether, n-propyl vinyl ether, i-butyl vinyl ether, n-butyl vinyl ether, styrene, alpha-methyl-styrene, acrylonitrile, methacrylonitrile, vinyl acetate, vinyl chloride, vinylidene-chloride, and vinyl fluoride, vinylidene fluoride, ethylene, a propylene, an isoprene, a chloroprene, a butadiene, etc. are mentioned.

[0031] Moreover, the above-mentioned monomer component may contain functional groups, such as a carboxyl group, a hydroxyl group, a methylol radical, an amino group, an amide group, an acid-amide radical, and a glycidyl group.

[0032] As a monomer which has the above-mentioned carboxyl group, an acrylic acid, a methacrylic acid, an itaconic acid, etc. are mentioned, and beta-hide ROKISHI ethyl acrylate, beta-hide ROKISHI ethyl methacrylate, beta-hide ROKISHI propylacrylate, beta-hydro KIPURO pill methacrylate, allyl alcohol, etc. are mentioned as a

monomer which has the above-mentioned hydroxyl group, for example.
[0033] As a monomer which has the above-mentioned methylol radical, N-methylol acrylamide, N-methylol methacrylamide, etc. are mentioned and dimethylamino ethyl acrylate, dimethylaminoethyl methacrylate, etc. are mentioned as a monomer which has an amino group, for example.
[0034] As a monomer which has the above-mentioned acid-amide radical, acrylamide, methacrylamide, etc. are mentioned and glycidyl acrylate, glycidyl methacrylate, the glycidyl allyl compound ether, etc. are mentioned as a monomer which has a glycidyl group, for example. These monomer components are used independently, and also two or more sorts are used together.
[0035] The above-mentioned natural wax is classified into a vegetable system, an animal system, a mineral system, and a petroleum system. As a vegetable system wax, a candelilla wax, carnauba wax, a rice wax, haze wax, jojoba oil, etc. are mentioned, for example. As an animal system wax, beeswax, lanolin, a spermaceti, etc. are mentioned, for example.
[0036] As a mineral system wax, a montan wax, an ozokerite, a ceresin, etc. are mentioned, for example. As a petroleum wax, paraffin wax, a micro crystallin wax, PETORORAMU, etc. are mentioned, for example.
[0037] If an end group, a carboxyl group, etc. which contain a fluorine in the above-mentioned binder exist, a charged particle will become easy to be charged in minus, and if the amino group and amide association exist in the above-mentioned binder, a particle will become easy to be charged in plus.
[0038] The method of distributing a coloring agent by the spray-drying method, a suspension-polymerization method, etc. as an approach of fixing a coloring agent to a charged particle in the approach of making a coat layer forming in a coloring agent front face, and a binder, for example etc. is mentioned. Especially as the approach of electrification nature grant of a charged particle, or its stabilization, although not limited, the surface treatment of a particle etc. is mentioned, for example other than the approach mentioned above.
[0039] In the case of titanium oxide, its 5 - 60 % of the weight is desirable, and the content of the coloring agent contained in a charged particle 12 has 3 - 30 desirable % of the weight to it, when it is carbon black. When not fulfilling the value which the content of the above-mentioned titanium oxide or carbon black mentioned above, a high reflection factor and black printing concentration are hard to be obtained. Moreover, since the dielectric constant of the whole charged particle becomes large when titanium oxide and carbon black contain too much, a charged particle does not migrate to electric field in a microcapsule, but it becomes easy to generate the problem of standing in a line in the direction of electric field in the shape of a string.
[0040] As a liquid dispersion medium 14 in which the liquid dispersion medium 14 enclosed into a microcapsule 10 has such a property that high insulation and transparent and colorless nature are called for at least, an aliphatic hydrocarbon solvent, an aromatic hydrocarbon solvent, etc. are mentioned, for example.
[0041] In the liquid dispersion medium 14, in order to make the distributed condition of a charged particle 12 good, the surfactant is contained. a surface active agent is classified into an anion system surface active agent, a cation system surface active agent, an amphoteric surface active agent, a non-ion system surface active agent, etc. according to the class of hydroxyl group combined with hydrophobic groups, such as paraffin, an olefin, and alkylbenzene, -- having -- this invention -- the above -- any surface active agent can be used.
[0042] However, although the addition changes also with the class of surfactant, and structures, it is desirable tc add in the range which does not reduce whenever [insulation / of the insulating liquid dispersion medium 14] to the degree of pole.
[0043] As an anion system surface active agent, that by which the hydrophilic group is constituted from carboxylate, a sulfate salt, a sulfonate, phosphate, etc. is mentioned, for example. As a cation system surfactant, that by which the hydroxyl group was constituted from a primary-amine salt, a secondary-amine salt, a tertiary-amine salt, quarternary ammonium salt, etc. is mentioned, for example.
[0044] As an amphoteric surface active agent, an amino acid mold amphoteric surface active agent, a betaine mold amphoteric surface active agent, etc. are mentioned, for example. If a non-ion system surface active agent is carried out, that by which the residue of polyhydric alcohol, such as a glycerol, and polyethylene glycols, such as ethyleneoxide, was used for the hydrophilic group, and residue, such as polyhydric alcohol, alkylphenol, a fatty acid, and fats and oils, was used for the hydrophobic group, for example is mentioned.
[0045] A microcapsule can be produced by the approach which already serves as a well-known technique in this industry. for example, in-situ by the polymerization of a monomer shown in interfacial polymerization as shown ir the phase separation method from a water solution as shown in U.S. Pat. No. 2800457, a 2800458 specification, etc., JP,38-19574,B, JP,42-446,B, JP,42-771,B, etc., JP,36-9168,B, JP,51-9079,A, etc. -- although there are law, the British patent No. 952807, a fusion distribution cooling method shown in a 965074 specification, it is not limited to this.

[0046] Although it may not be limited by the above-mentioned capsule manufacture approach as a formation ingredient of the outer wall section of a microcapsule 10 especially as long as the outer wall section is producible, but mineral matter or an organic substance is sufficient, the quality of the material which makes light fully penetrate is desirable.
[0047] As an example of the formation ingredient of the above-mentioned outer wall section, gelatin, gum arabic, starch, sodium alginate, polyvinyl alcohol, polyethylene, a polyamide, polyester, polyurethane, polyurea, polyurethane, polystyrene, a nitrocellulose, ethyl cellulose, methyl cellulose, a melamine/formaldehyde resins, ureas/formaldehyde resins, these copolymerization objects, etc. are mentioned, for example.
[0048] The volume of each charged particle 12 in a microcapsule 10 is 1.5 to 25 capacity % to the volume of a microcapsule 10, respectively, and, as for total of the volume of all the charged particles 12, it is desirable that it is 1.5 to 50 capacity % to the volume of a microcapsule 10.
[0049] The opposite color particle which is not the foreground color made into the purpose for the volume of each charged particle 12 to be under 1.5 capacity % also touches an observer's eyes, therefore it is [contrast falls and] in sight. On the other hand, if 25 capacity % is exceeded, since the charged particle 12 is too large, it will be hard coming to move the interior of a microcapsule 10. Moreover, the image which clarified since there were too few amounts of a charged particle 12 that total of the volume of all the charged particles 12 is under 1.5 capacity % is not formed, but since there are too many amounts of a charged particle 12 when 50 capacity % is exceeded on the other hand, it is hard coming to move the interior of a microcapsule 10, therefore the responsibility over control electric field falls.
[0050] As for the particle diameter of a charged particle 12, it is desirable that it is 1 / 1000 - 1/5 to the particle diameter of a microcapsule 10, and when expressed with volume mean particle diameter / number mean particle diameter, as for degree of dispersion of the particle size distribution of a charged particle 12, it is desirable that it is 1-2. Moreover, as for the particle diameter of a microcapsule 10, it is desirable that it is 5-200 micrometers.
[0051] Next, the actuation at the time of making electric field act on this microcapsule 10 is explained. Drawing 2 is the explanatory view having shown typically the condition of black charged particle 12a after making electric field act on a microcapsule 10, and white charged particle 12b. When electric field are not acting, as shown in drawing 1 , black charged particle 12a and white charged particle 12b are distributed disorderly.
[0052] However, when an electrical potential difference is impressed in the fixed direction, as black charged particle 12a and white charged particle 12b which are carrying out distributed suspension into the liquid dispersion medium 4 migrate to hard flow respectively according to an operation of electric field, for example, are shown in the liquid dispersion medium 14 containing this microcapsule 10 for example, at drawing 2 , white charged particle 12b condenses up, and, on the other hand, below, black charged particle 12a condenses.
[0053] For this reason, when this microcapsule 10 is seen from the upper part, black charged particle 12a condensed with the down side is concealed by white charged particle 12b, and is not visible, and the part of a microcapsule 10 is visible to white.
[0054] On the other hand, although not shown in drawing, when the electrical potential difference of drawing 2 and an opposite direction is impressed, black charged particle 12a is condensed to the up side, and since white charged particle 12b is condensed to the down side, the part of this microcapsule 10 looks black from the upper part. Therefore, it becomes possible by changing the direction of electric field to form a predetermined image in the screen. Moreover, it also becomes possible to display the image containing colors, such as red, blue, and yellow, by enclosing the charged particle 12 which contains colors, such as red, blue, and yellow, in a microcapsule 10.
[0055] Drawing 3 is the sectional view having shown typically an example using the display device of this invention of a display. It sets to this display 20, many transparent electrodes 24 are formed in the top-face side of the flexible medium 22 by which the microcapsule 10 was distributed and fixed to the interior in the shape of a plane view array, and transparence or the opaque electrode 25 is formed in the inferior-surface-of-tongue side.
[0056] Moreover, the power source which is not illustrated is connected to the transparent electrode 24 and electrode 25 of these each, and the electrical potential difference of + or - is impressed independently on the basis of the electrical potential difference of an electrode 25 between each transparent electrode 24 and an electrode 25, respectively.
[0057] Moreover, the transparent electrode 24 is larger than the configuration which carried out plane view of the microcapsule 10, and at least one microcapsule 10 per transparent electrode 24 corresponds, and it is prepared.

[0058] The film made of resin, paper, etc. are mentioned as a flexible medium 22. If the electrical potential difference according to the image which it is going to display is impressed between each transparent electrode 24 of this display 20, and an electrode 25, respectively, as shown in drawing 3 , black charged particle 12a or white charged particle 12b will condense to the up side, and the image corresponding to the image which it is going to display by this will be formed. Moreover, since the state of aggregation of a charged particle 12 does not change a power source even if off, unless the electrical potential difference corresponding to another image is impressed between each transparent electrode 24 and an electrode 25, respectively, the display condition of the image is maintained.
[0059] Drawing 4 is the sectional view having shown typically another example using the display device of this invention of a display. In this display 30, it differs from the display shown in drawing 3 , and an electrode is not formed in both sides of the flexible medium 32 by which the microcapsule 10 was distributed and fixed, but it is the purpose which passes the flexible medium 32, and the fixed electrode 34 of a long and slender tabular pair is formed through the power source 36.
[0060] This fixed electrode 34 is the set of the electrode of a large number prepared in the monotonous die-length direction, and can impress a predetermined electrical potential difference now independently between the fixed electrodes 34 used as each pair.
[0061] Therefore, between fixed electrodes 34 can be passed for the flexible medium 32 containing a microcapsule 10 at a predetermined rate, and the image corresponding to the image which is going to impress and display electric field as occasion demands from a fixed electrode 34 in the case of passage can be made to form in a display 30.
[0062] As mentioned above, in the display device of this invention, by using the charged particle containing titanium oxide and carbon BURATSU, a reflection factor and a contrast ratio are high, are legible, and become realizable [the display device in which it has a rewritable image etc.]. Moreover, in the above-mentioned display device, after image formation, even if it intercepts control by electric field, it becomes possible to hold an image in the condition as it is.
[0063]
[Example] Although an example is given to below and this invention is explained to it in more detail, this invention is not limited only to these examples.
[0064] In the case of the white coloring agent, the coloring agent shown in examples 1-8 and example of comparison 1 table 1 manufactured many the white charged particles and black charged particles whose mean particle diameter which in the case of the black coloring agent was distributed and was fixed by polyamide resin in polystyrene resin, respectively is about 7 micrometers.
[0065] Next, the charged particle manufactured by the above-mentioned approach was added into 100 cc of 1:1 water solutions of the aliphatic hydrocarbon solvent of 5% polystyrene sulfonate which is an emulsifier which are a sodium salt water solution and a liquid dispersion medium a part, with the homogenizer, 6000 revolutions, it stirred for 5 minutes and the emulsion which the liquid dispersion medium which contains a white charged particle and a black charged particle in a water solution distributed to homogeneity was obtained.
[0066] Independently, commercial melamine powder was added to the formaldehyde 37% water solution, with the sodium-hydroxide solution, it adjusted to PH9.0, it heated for 30 minutes at the water temperature of 60 degrees C, and the melamine / formaldehyde prepolymer was obtained. Next, the melamine / formaldehyde prepolymer was added to the above-mentioned emulsion, and it held for 5 hours in the condition of having heated so that water temperature might become 80 degrees C, stirring by 100 to 300 rotation by a horse mackerel homomixer etc., it adjusted to PH7 after that, and cooled to ordinary temperature.
[0067] Consequently, the wall material which becomes the surroundings of the liquid dispersion medium containing a white charged particle and a black charged particle from a melamine/formaldehyde resins deposited, and the microcapsule which connotes a charged particle was obtained.
[0068] At this time, the rate of the coloring matter which each charged particle to the volume of a microcapsule contains is shown in Table 1. moreover, the mean particle diameter of a microcapsule -- 40-70 micrometers it was . Next, after taking out the microcapsule manufactured by the above-mentioned approach and distributing and fixing on a flexible medium, it has arranged to inter-electrode, and 100v [/mm] control electric field were ****(ed), image display was performed, and the image shown below was evaluated.
[0069] OD value (optical density) was measured as an evaluation approach (1) white reflection factor measuring instrument using the reflection density meter (Macbeth RD914), and reflection factor T (%) was computed by -log10 T=OD.
(2) It is a reflection factor Tblack about a black printing part as well as the case of a contrast ratio white

reflection factor. It measures and is contrast ratio =Tblack. : It asked by Twhite =1: (Twhite/Tblack). The average (72% of white reflection factors, contrast ratio 15:1) of the laser beam printer image sample under various conditions was applied to the valuation basis (SURESSHI value) of the above-mentioned image quality.

[0070] Capacity [in the class of each used coloring agent and the microcapsule of each charged particle] % (content) and an evaluation result are shown in Table 1.

[0071]

[Table 1]

	着色剤及び該着色剤を含む帯電粒子の含有率					表示装置の特性		
	白色	含有率(容量%)	黒色	含有率(容量%)	白色反射率(%)	黒色反射率(%)	コントラスト比
実施例1	酸化チタン	10	カーボンブラック	5	75	4.5	16.7:1
実施例2	酸化チタン 酸化アルミニウム	3 10	カーボンブラック	5	73	3.8	19.2:1
実施例3	酸化チタン	10	カーボンブラック Paliotal black d 0080(bast)	2 3	77	5.1	15.1:1
実施例4	酸化チタン 酸化アルミニウム	3 10	カーボンブラック Paliotal black d 0080(bast)	2 3	73	4.7	15.5:1
実施例5	酸化チタン	10	lurazol deep blue eb(bast)	飽和	77	9	8.5:1
実施例6	酸化チタン	10	カーボンブラック	2	79	8.3	9.5:1
実施例7	酸化チタン	10	カーボンブラック Paliotal black d 0080(bast)	1 3	80	6.8	11.7:1
実施例8	酸化チタン 酸化アルミニウム	2 10	カーボンブラック	5	70	3.5	18.4:1
比較例1	なし	0	カーボンブラック	5	43	5	8.6:1

注) paliotal black d 0080 (bast) : diamond black
lurazol deep blue eb (bast) : C. I. acid black 2

[0072] Since the inside of a microcapsule consists of dispersion mediums containing two or more sorts of charged particles and surface active agents and the above-mentioned charged particle contains either [at least] titanium oxide or the carbon black, with the display using the display device of this invention, the high reflection factor and the image of a high contrast ratio are formed, so that more clearly than the result shown in Table 1.

[0073]

[Effect of the Invention] As explained above, according to the display device according to claim 1, within the

dispersed system which enclosed the charged particle which moves inter-electrode to impression of electric field in a dispersion medium By changing the distribution condition of the above-mentioned charged particle under an operation of the electrical potential difference for control In the display device to which give change to an optical reflection property and made it make a necessary display action carry out The above-mentioned dispersed system consists of at least two or more kinds of charged particles by which endocyst was carried out to the microcapsule, and a dispersion medium containing a surfactant. The above-mentioned charged particle Since at least one side is included among titanium oxide and carbon black, by changing the impression condition of an electrical potential difference, change can be given for the optical reflection property using this display device of a display, and, moreover, a low battery is enough as the applied voltage at this time.

[0074] Moreover, by using the charged particle which contains at least one side among titanium oxide and carbon black, a reflection factor and a contrast ratio are high and can form a legible image etc. Moreover, after image formation, even if it intercepts control by electric field, it is possible to hold an image in the condition as it is, and it has a memory.

[0075] Moreover, since the charged particle is contained in the microcapsule, a charged particle condenses at the time of an operation of electric field, and even if it changes the impression condition of an electrical potential difference repeatedly, the fall phenomenon of image quality is not generated. Moreover, the display containing a rewritable flexible medium can be offered by making film-like base materials, such as paper, fix a microcapsule. Furthermore, since the display using the above-mentioned display device can be manufactured comparatively easily, it can offer a cheap display.

[0076] Moreover, according to the display device according to claim 2, since a charged particle contains both titanium oxide and carbon black, it can offer a higher reflection factor and the display of high contrast.

[0077] Moreover, since according to the display device according to claim 3 the volume of each charged particle is below 25 capacity % more than 1.5 capacity % to the volume of a microcapsule, respectively and total of the volume of all charged particles is below 50 capacity % more than 1.5 capacity % to the volume of a microcapsule, a charged particle can show good responsibility to electric field, and can offer the display which has a high contrast ratio.

[Translation done.]